BNC Berkeley Nucleonics

Test, Measurement and Nuclear Instrumentation since 1963

- 20 independent delay channels,
- 100 ps delay resolution,
- 10 seconds delay range,
- Adjustable output level, polarity and width.

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Edition

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Ed.	Date	Description
1	1/2013	Creation

Reference documents

	Documents	Reference
DR 1		
DR 2		
DR 3		
DR 4		

1. GENERAL INFORMATION

1.1. Description

The 745-20C-T Digital Delay Generator provides twenty independent delayed output pulses.

Delays up to 10 seconds may be programmed with 100ps resolution and channel to channel jitter less than 50 ps rms.

BNC outputs deliver pulses, with adjustable level (3 to 6V) and polarity, into 50Ω load.

A trigger out signal (T0) is provided to reference the delayed outputs in different operation mode.

745-20C-T parameters may be remote controlled via an Ethernet interface (10/100Mb/s) (basic commands or Web page).

Instrument Options

Option 1	Clock output (same frequency as specified clock input)
Option 2	2.5 to 10 V channels, 1 ns rise time, positive polarity
Option 3	Amplitude up to 20 V, adjustable
Option 4	Maximum amplitude up to 32V (fixed)
Option 5	1 ps resolution
Option 6	Front panel for local control (touchscreen)
Other	trigger source saved after shut down, Immediate modification of output pulse without validation, specific options available upon request.

Package contents:

The box you receive should contain the following: o 745-20C-T instrument,
o Power cable, o User's manual,
o CD containing DLL and Labview driver.

BERKELEY NUCLEONICS product:

For more information about Berkeley Nucleonics product see our web site:
www.berkeleynucleonics.com

1.2. Installation

1.2.1. Power source

The 745-20C-T can be operated from 90 VAC to 240 VAC nominal supply source.

The maximum power consumption of the 745-20C-T is 80 W.

1.2.2. Power cord

The 745-20C-T comes with a removable power cord for European usage. It has a three contact plug for connection to both the power source and protective ground.

1.3. Operating temperature

The 745-20C-T can be operated where the ambient air temperature is 0°C to 35°C and can be stored in ambient temperature from - 10°C to + 60°C. The 745-20C-T is cooled by air circulation. To prevent instrument damage a clearance of 2 inches on the side and 1 inch on the rear must be maintained for proper cooling.

1.4. Rack mounting information

The 745-20C-T will fit a 19 inch rack.

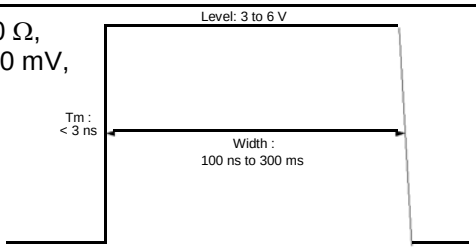
1.5. Self-test

The model, firmware version, serial numbers for the units and self-test will be displayed a certain time after the power is applied, depending on the ambient temperature. The self-test should not exceed 1 minute.

1.6. Optimal performance

To ensure optimal performance, it is recommended to wait 1 hour after the equipment's switching on.

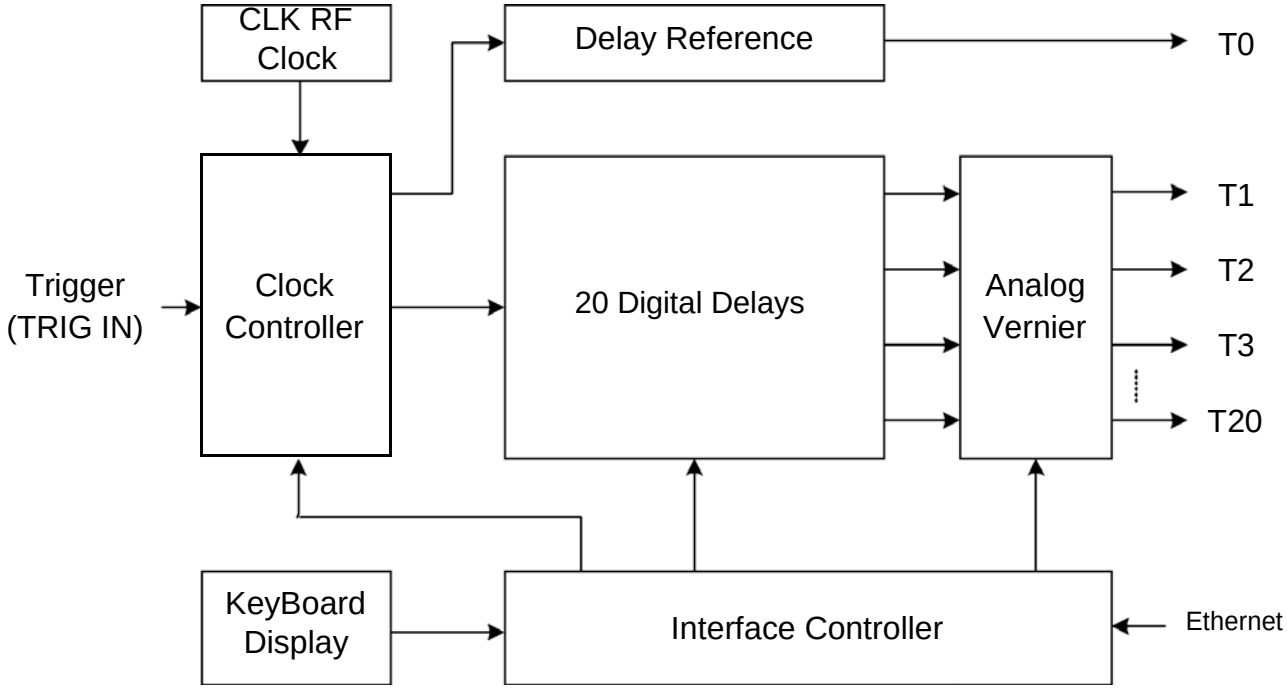
2. SPECIFICATIONS

Delays	
Channels	20 independent delay channels
Range	0 to 10 seconds
Resolution	100 ps
RMS Jitter	< 50 ps + delay x 10^{-7} rms
Internal time base	
Frequency	CLK RF
Stability	10^{-8}
Trigger	
Single shot source SS1 and SS2 (synchronous of F3)	Ethernet or Web page or trigger input
Synchronous repetitive triggers	3 frequencies: F1> F2 > F3 F1: 1000, 500, 200, 100, 50, 20, 10, 5, 2 Hz F2: 200, 100, 50, 20, 10, 5, 2, 1, 0.5 Hz F3: 50, 20, 10, 5, 2, 1, 0.5, 0.2, 0.1 Hz
Outputs	
Delayed output (T1 to T20)	Positive or negative pulse into 50 Ω, Amplitude 3 to 6 V , resolution: 10 mV, Rise time : < 5 ns, Fall time: < 10 ns, Width: 100 ns to 300 ms Connector type BNC, 
Reference output (T0)	Positive pulse into 50 Ω, amplitude 3 to 6V, resolution 10 mV Rise time < 5 ns, fall time < 10 ns, width 100ns to 300 ms Connector type BNC
CLK RF / 2 clock output (option)	Frequency: CLK RF / 2, > 1V / 50 Ω, Connector type BNC,
Interface	
Front panel (option), Ethernet 10/100 Mb/s, Internet (Web page)	
General	
Power Required	90 – 220 V / 50 – 60 Hz / 1 A.
Weight	Net: < 10 kg
Dimensions	19'', 2 U, 320 mm without handles

3. OPERATING INFORMATION

3.1. Principle – Block diagram

The principle of the programmable delay generator is described in the figure bellow:



The sequence follows 3 phases:

- After on insertion delay a reference pulse appear at the “T0” output,
- Following the reference a pulse will appear on each channel after a specified delay,
- At the end of sequence, after last delayed pulse outputs, the delay generators are initiate.

When a sequence is in progress the instrument will not respond to a trigger event.

Each delayed values output pulse (T1 to T20) can be independently adjustable in level and width. All values (delay, level, width) are saving when shut down the equipment, except the trigger source (option). After the power on, all trigger sources are off (INH).

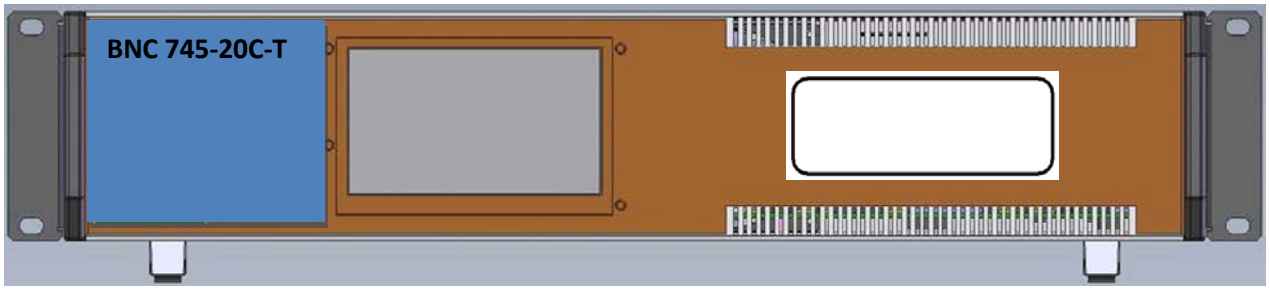
3.2. Local command and parameter

The following chart described the trigger source, amplitude and width for each trigger out T0 and delayed output T1 to T20:

	745-20C-T T0 to T20
TRIGGER SOURCE	Inhibited (INH)
	Repetitive F1 (F1)
	Repetitive F2 (F2)
	Repetitive F3 (F3)
	Single Shot 1 (SS1)
	Single Shot 2 (SS2)
AMPLITUDE	3 V to 6 V in 10 mV steps
WIDTH	100 ns to 300 ms in CLK RF steps

3.3. Front panel operation summary

The 745-20C-T front panel consists of a LCD display and 3 BNC.



3.3.1. LCD

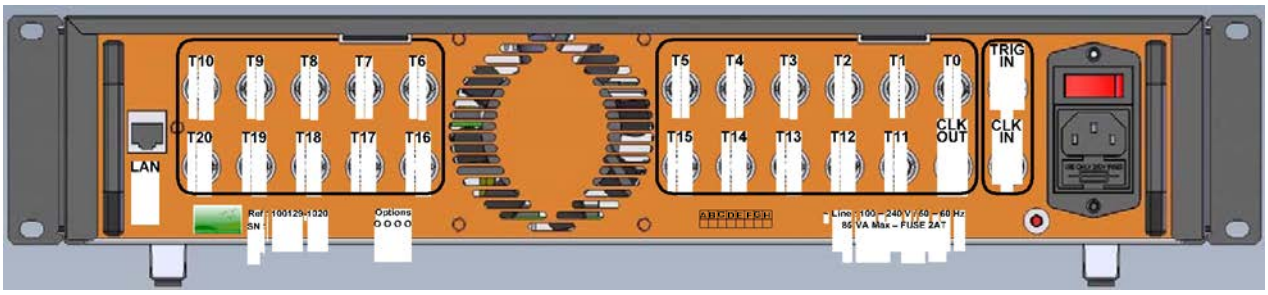
The LCD is screen tactile (option).

3.3.2. AUX 1 to 3

TBD.

3.4. Rear panel operation summary

All input or output connections to the 745-20C-T are made on the rear panel.



3.4.1. Power switch

The unit is turned on by depressing the POWER button. The 745-20C-T can be operated from 90 to 240 V at a line frequency of 50 – 60 Hz.

3.4.2. Ethernet port (LAN)

The RJ45 Ethernet rear panel connector allows a computer to control the 745-20C-T.

3.4.3. Trigger input (TRIG IN)

BNC connector for application of the trigger input signal that generates the single shot sequence.

3.4.4. Trigger ouptut (T0)

BNC connector for signal output. This is the output reference. This should be terminated in 50Ω.

3.4.5. Clock output (CLK OUT)

BNC connector for signal output. This is the 85 MHz reference. This should be terminated in 50 Ω.

3.4.6. Clock input (CLK IN)

BNC connector for signal input. This is the 85 MHz reference.

3.4.7. Trigger output T1 to T20

BNC connectors for delayed signal outputs. This should be terminated in 50 Ω.

3.5. Default value

The default values are the following:

- IP ADRESS : 99.0.0.18,
- GATEWAY ADRESS : 99.0.0.01,
- NET MASK : 255.0.0.0,
- F1 : 1000 Hz,
- F2 : 100 Hz,
- F3 : 10 Hz
- Level: 5.00 V,
- Width: 500 ns.

4. CONNECTING TO THE INSTRUMENT VIA ETHERNET

4.1. Generality

For connecting over the LAN, you would do have the following:

- Connect the instrument to the LAN physically,
- On the user interface, either specify the LAN address,
- On the control PC, enter the instrument's IP address,
- After the connection has been established, the following commands can be used to modify the settings:
  - Set the instrument's IP address with: IP XXX.XXX.XXX.XXX
  - Query the instrument's IP address with: IP? ⇒ :IP XXX.XXX.XXX.XXX
  - Set the instrument's IP mask with: NM XXX.XXX.XXX.XXX
  - Query the instrument's IP mask with: NM? ⇒ :NM XXX.XXX.XXX.XXX
  - Set the instrument's IP gateway: GW XXX.XXX.XXX.XXX
  - Query the instrument's IP gateway with: GW? ⇒ :GW XXX.XXX.XXX.XXX

4.2. Command structure

745-20C-T is compatible with all command of the LIL timing system.

Each command description has at least some of the following items:

- Full command syntax,
- Form Set / Query,
- Brief description,
- Parameters,
- RST value,
- Specified limits.
- Example.

4.2.1. *IDN?

Syntax:	*IDN?
Form:	Query
Description:	Queries instrument identification. Response gives instrument model, serial number and firmware version.
Parameter:	-
RST value	-
Example:	GFTy/MIPSI,745-20C-T,SN101/000000,V1.0
	Instrument model: 745-20C-T
	Serial number: 101,
	Firmware version: 1.1

4.2.2. DELAY

Syntax:	DELAY Tn,<D>
	DELAY? Tn
Form:	Set & Query
Description:	Delay time of channel Tn is set to <D> picosecond relative to T0 channel
Parameter:	Tn: channel number 1 to 20
	<D> : picosecond delay
RST value	-
Specified limit	0 to 9 999 999 999 999 picoseconds
Example:	Set : program 1 ns to channel 2 : DELAY T2,1000
	Query: DELAY? T2 => :DELAY T2,1000

4.2.3. TRIG

Syntax:	TRIG Tn,<T>
	TRIG? Tn
Form:	Set & Query
Description:	Set channel T0 trigger mode to Frequency 1, Frequency 2, Frequency 3, Single shot 1, Single shot 2.
Parameter:	Tn : channel number 0 to 20
	<T>: trigger mode :F1, F2, F3, SS1, SS2, INH
RST value	INH
Example:	Internal mode 1 to channel 2 : TRIG T2,F1
	Query mode to channel 2 : TRIG? T2 => :TRIG T2,F1

4.2.4. VOLTAGE LEVEL

Syntax:	AMPL Tn,<V>
	AMPL? Tn
Form:	Set & Query
Description:	Set channel Tn to voltage level <V>
Parameter:	Tn : channel number 0 to 20
	<V> : voltage level in mV
RST value	-
Specified limit	3000 to 6 000 mV
Example:	3.5 V to channel 4 : AMPL T4,3500
	Query mode to channel 4: AMPL? T4 => :TRIG T4,3500

4.2.5. WIDTH

Syntax:	WIDTH Tn,<W>
	WIDTH? Tn
Form:	Set & Query
Description:	Set channel Tn at specified <W> width
Parameter:	Tn: channel number 0 to 10
	<W> : width in ns
RST value	-
Specified limit	100 to 300 000 000 ns
Example:	250 ns to channel 4 : WIDTH T4,250
	Query mode to channel 4 : WIDTH? T4 => :WIDTH T4,2500

4.2.6. POLARITY

Syntax:	TTL Tn,<P>
	TTL? Tn
Form:	Set & Query
Description:	Set channel Tn at specified <P> polarity (positive or negative)
Parameter:	Tn : channel number 0 to 20
	<P> : polarity : POS, NEG
RST value	POS
Example:	Negative-going pulses on channel 3 : TTL T3,NEG
	TTL? T3 => :TTL T3,NEG

4.2.7. FREQUENCY

Syntax:	FREQ Fn,<F>
	FREQ?
Form:	Set & Query
Description:	Set the frequency in internal mode
Parameter:	Fn : F1, F2 or F3
	<F> : frequency in Hz
RST value	-
Specified limit	0.10 to 1 000 Hz
Example:	FREQ F2,100
	FREQ? F2 => :FREQ F2,100

4.2.8. RUN

Syntax:	RUN
Form:	Set
Description:	Software trigger
Parameter:	-
RST value	OFF
Example:	RUN

4.2.9. STAT

Syntax:	STAT CLEAR
	STAT? <XXXX>
Form:	Set & Query
Description:	Equipment information
Parameter:	<XXXX> :
	TEMP: Temperature
	POPT: Optical power
	CLK: INTERNAL / EXTERNAL
	POW : Level + 6 V, -6 V, +3.3 V, + 1.8 V and + 11 V
	TRIG: trigger channel 1 to 20
RST value	OFF
Example:	STAT CLEAR : clear the information
	STAT? TEMP => :STAT TRET,10.00
	STAT? POPT=> :STAT POPT,-19,69
	STAT? CLK => :STAT CLK,INTERNAL
	STAT? POW => :STAT POW,6.00,-5.99,3.35,1.75,11.45
	STAT? TRIG => :STAT TRIG,1,0,0,1,0,0,0,0,0,0,0,0,0,0,0,1,1,0,0,0 (1 if Channel 1 to 20 is trigged)
	STAT? MTRIG => :STAT MTRIG,0 (1 if single shot is trigged)

4.2.10. IP adress

Syntax:	IP x.x.x.x
	IP?
Form:	Set & Query
Description:	IP Adress
Parameter:	x.x.x.x : IP address
RST value	Off
Example:	IP 172.17.23.6
	IP? => :IP 172.17.23.6

4.2.11. Net mask adress

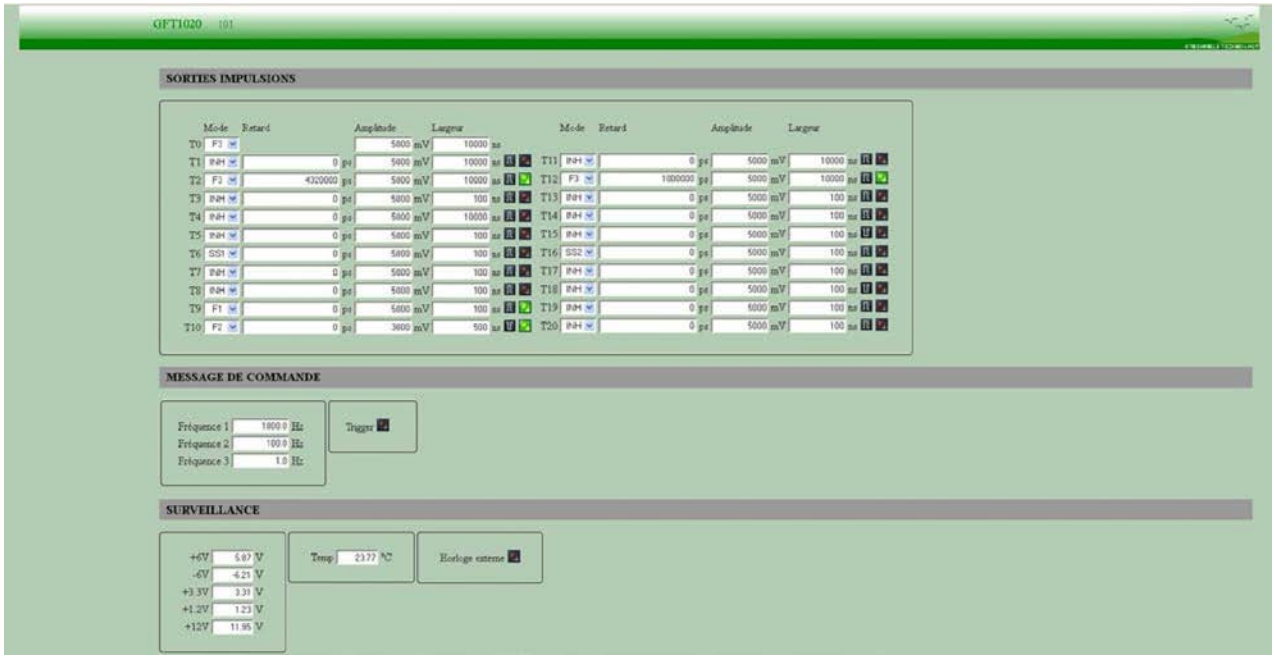
Syntax:	NM x.x.x.x
	NM?
Form:	Set & Query
Description:	Net mask Address
Parameter:	x.x.x.x : NW address
RST value	Off
Example:	NW 255.255.0.0
	NW? => :NW 255.255.0.0

4.2.12. GW adress

Syntax:	GW x.x.x.x
	GW?
Form:	Set & Query
Description:	GW Address
Parameter:	x.x.x.x : GW address
RST value	Off
Example:	GW 172.17.23.6
	GW? => :GW 172.17.23.6

4.3. Remote control via internet

With Internet explorer or Firefox, you can open a web page to drive the 745-20C-T:



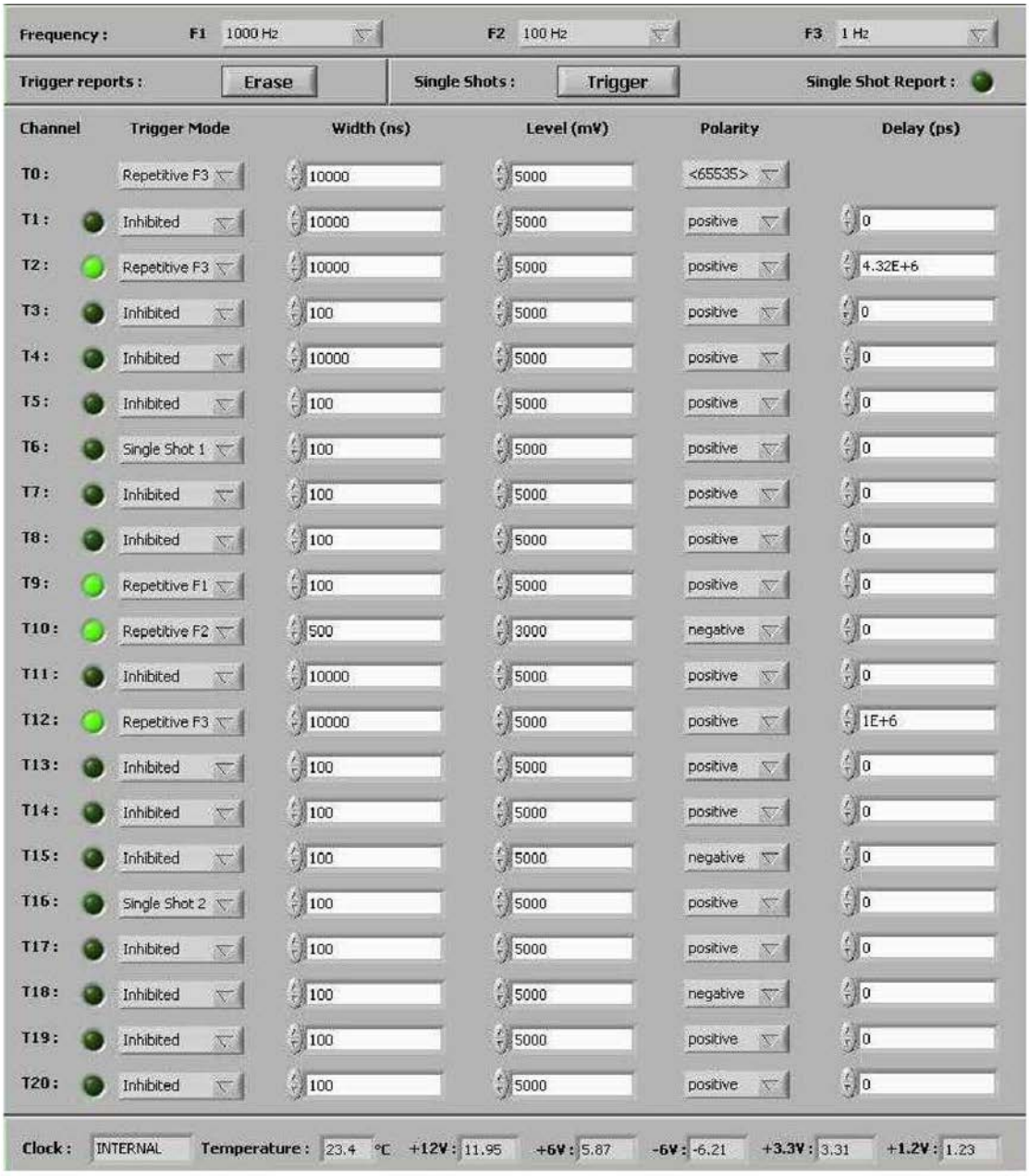
5. SOFTWARE

The 745-20C-T comes with DLL drivers for Windows XP or Seven. Our primary objective in designing software drivers is to get the user up and running as quickly as possible.

Software drivers are provides as a Dynamic Link Library (DLL) which is compatible with most 32-bit windows based development software. The main program is written on Labview v11 or later.

The listing of files is the following:

- 745-20C-T: main program,


Frequency : F1 1000 Hz F2 100 Hz F3 1 Hz
Trigger reports : Erase Single Shots : Trigger Single Shot Report :
Channel Trigger Mode Width (ns) Level (mV) Polarity Delay (ps)
T0 : Repetitive F3 10000 5000 <65535>
T1 : Inhibited 10000 5000 positive 0
T2 : Repetitive F3 10000 5000 positive 4.32E+6
T3 : Inhibited 100 5000 positive 0
T4 : Inhibited 10000 5000 positive 0
T5 : Inhibited 100 5000 positive 0
T6 : Single Shot 1 100 5000 positive 0
T7 : Inhibited 100 5000 positive 0
T8 : Inhibited 100 5000 positive 0
T9 : Repetitive F1 100 5000 positive 0
T10 : Repetitive F2 500 3000 negative 0
T11 : Inhibited 10000 5000 positive 0
T12 : Repetitive F3 10000 5000 positive 1E+6
T13 : Inhibited 100 5000 positive 0
T14 : Inhibited 100 5000 positive 0
T15 : Inhibited 100 5000 negative 0
T16 : Single Shot 2 100 5000 positive 0
T17 : Inhibited 100 5000 positive 0
T18 : Inhibited 100 5000 negative 0
T19 : Inhibited 100 5000 positive 0
T20 : Inhibited 100 5000 positive 0
Clock : INTERNAL Temperature : 23.4 °C +12V : 11.95 +6V : 5.87 -6V : -6.21 +3.3V : 3.31 +1.2V : 1.23

- DLL or vi:
    - o *.dll or *.vi : set the value,
    - o *_val.dll or *_val.vi : query the value.

Delay
void Delay(LVRefNum *IDConnexionIN, uInt8 Channel, floatExt DelayPs, TD1 *entrEDErreurPasDErreur, LVRefNum *IDDeConnexionOUT, TD1 *errorOut)

Delay_val
void Delay_val(LVRefNum *IDConnexionIN, uInt8 Channel, TD1 *entrEDErreurPasDErreur, LVRefNum *IDDeConnexionOUT, uInt8 *ChannelOut, floatExt *DelayPs, TD1 *errorOut)

Identifiant_val
void Identifiant_val(LVRefNum *IDConnexionIN, TD1 *entrEDErreurPasDErreur, LVRefNum *IDDeConnexionOUT, LStrHandle *dataOut, TD1 *errorOut)

Softtrigger
void Softtrigger(LVRefNum *IDConnexionIN, TD1 *entrEDErreurPasDErreur, LVRefNum *IDDeConnexionOUT, TD1 *errorOut)

Trigger
void Trigger(LVRefNum *IDConnexionIN, uInt8 Channel, uInt16 Trigger2, TD1 *entrEDErreurPasDErreur, LVRefNum *IDDeConnexionOUT, TD1 *errorOut)

trigger_val
void Trigger_val(LVRefNum *IDConnexionIN, uInt8 Channel, TD1 *entrEDErreurPasDErreur, LVRefNum *IDDeConnexionOUT, uInt8 *ChannelOut, uInt16 *TriggerOut, TD1 *errorOut)

sta_val
void Sta_val(LVRefNum *IDConnexionIN, TD1 *entrEDErreurPasDErreur, LVRefNum *IDDeConnexionOUT, TD2Hdl *Surveillance, TD1 *errorOut)